

Session 4 MODIS NDVI Anomalies

Introduction

An NDVI anomaly is the difference between the average NDVI for a particular month of a given year and the average NDVI for the same month over a specified number of years. This approach can be used to characterize the health of vegetation for a particular month and year relative to what is considered normal, which is a good indicator of drought or declining vegetation health. For this exercise we will be evaluating the NDVI values of July 2015 compared to July 2001 through 2010 in a region in California. California has been experiencing drought conditions between 2012 to 2015, so we expect to see significant NDVI anomalies in the July 2015 image.

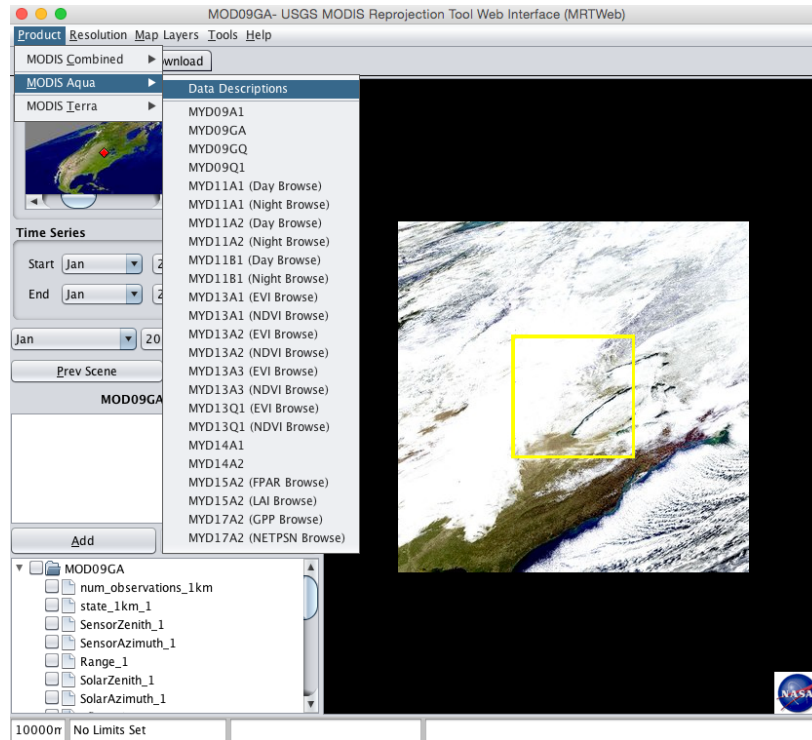
Part 1: Download MODIS NDVI images

First we will locate and download several MODIS NDVI images. To do this we will use the USGS MODIS Reprojection Tool Web Interface, or MRTWeb (<https://mrtweb.cr.usgs.gov>).

- Go to <https://mrtweb.cr.usgs.gov>
- You will need to register (free) to use this web tool. Click on **Register** to enter a Username and Password. You will also need to make sure that you have the most current version of Java and that pop-up blocker is turned off. MRTWeb will be opened in a separate window that is activated like a pop up.
- Check your email to activate your account. Once you have successfully logged in, click on the MRTWeb link above again. The Earthdata Login will then ask you to Authorize Application. Click on the green **Authorize** button.

Before we select the MODIS NDVI images to download we need to know the name of the MODIS NDVI product.

- Go to **Product/MODIS Terra/Data Descriptions**. That will bring up the MODIS products table. Scroll down until you see **Vegetation Indices** under the **Product** column. Look to the right of that until you see 250 (250m spatial resolution). You will notice that the product is MOD13Q1. By clicking on the MOD13Q1 link, you will get a full description of that product.



- Go back to the MRT web interface. Go to **Product/MODIS Terra** and select **MOD13Q1 (NDVI browse)**.

Now you'll need to select the area that you are interested in. In this exercise, we are going to select California.

- In the smaller **Locator Map** (upper left corner), click on an area that is in or close to California. When you do this, you should see that the larger window also moves to select that same scene.
- In the bottom left box under the **Add** button, check **250m 16days NDVI**.

Now you will need to select the dates that you are interested in. In this exercise, we are choosing the month of July for the years 2001-2010. You cannot use the Time Series options because that will give you consecutive months for the years that you choose. Instead you will need to select one year at a time.

- Select the month July (just above Prev Scene). Then select the year 2001. Click **Go**, and then click **Add**. Go back and select July 2002, and complete the same process for 2002 through 2010, adding each image to the list. Do the same for July 2015.
- Click on the **Process** tab at the top of the panel. Processing type will be **Reproject**. Give it a job name (NDVI). Leave the spatial subset as blank. Leave the Resampling as is (Nearest Neighbor, Native). Under **Projection**, put **Geographic, Datum WGS84**. Output is **Geotiff**. Click the **Process** button. You will then see a pop-up that states that your job has been submitted. Click **OK**.

The screenshot shows the 'MOD13Q1 (NDVI Browse)- USGS MODIS Reprojection Tool Web Interface (MRTWeb)' with the 'Process' tab selected. The interface includes a menu bar with 'Product', 'Resolution', 'Map Layers', 'Tools', and 'Help'. Below the menu are three tabs: 'Selection', 'Process', and 'Download'. The 'Process' tab contains several sections: 'Processing Type' with a 'Reproject' dropdown; 'Job Name' with a text input 'NDVI' and a note '(use only alphanumeric characters)'; 'Spatial Subset' with a dropdown, 'Upper Left' and 'Lower Right' labels, and 'Latitude' and 'Longitude' input fields; 'Resampling' with 'Type' (Nearest Neighbor) and 'Pixel Size' (Native) dropdowns; 'Projection' with 'Geographic' and 'Datum' (WGS84) dropdowns; 'Output' with a 'File Type' (GEOTIFF) dropdown; and a 'Process' button.

- Open the **Download** tab at the top and you will see the job process. It may take a few minutes to download these images, depending on your connection.
- Once the job is complete, click **Download** and an ftp window will come up. You will notice that there are several files available for download. Download the files that have the .tif suffix. You can click on each file separately to download it to your computer.
- Remember the MODIS naming convention we previously reviewed. This contains the date for each image and will help you to make sure you have downloaded all the files you need.

Index of /NDVI_MRT1453739912517

Name	Last modified	Size	Description
Parent Directory		-	
MOD13Q1.A2001193.h08v05.005.2007039160420.hdf	25-Jan-2016 10:38	222M	
MOD13Q1.A2002193.h08v05.005.2007178024111.hdf	25-Jan-2016 10:38	209M	
MOD13Q1.A2003193.h08v05.005.2008314113831.hdf	25-Jan-2016 10:38	208M	
MOD13Q1.A2004193.h08v05.005.2007299171858.hdf	25-Jan-2016 10:38	216M	
MOD13Q1.A2005193.h08v05.005.2008215140853.hdf	25-Jan-2016 10:38	220M	
MOD13Q1.A2006193.h08v05.005.2008137040138.hdf	25-Jan-2016 10:38	218M	
MOD13Q1.A2007193.h08v05.005.2007215163619.hdf	25-Jan-2016 10:38	215M	
MOD13Q1.A2008193.h08v05.005.2008211025744.hdf	25-Jan-2016 10:39	212M	
MOD13Q1.A2009193.h08v05.005.2009213075055.hdf	25-Jan-2016 10:39	221M	
MOD13Q1.A2010193.h08v05.005.2010212111259.hdf	25-Jan-2016 10:39	219M	
MOD13Q1.A2015193.h08v05.005.2015233174246.hdf	25-Jan-2016 10:39	221M	
MOD13Q1.MRTWEB.A2001193.005.250m 16 days NDVI.tif	25-Jan-2016 10:39	79M	
MOD13Q1.MRTWEB.A2002193.005.250m 16 days NDVI.tif	25-Jan-2016 10:39	79M	
MOD13Q1.MRTWEB.A2003193.005.250m 16 days NDVI.tif	25-Jan-2016 10:39	79M	
MOD13Q1.MRTWEB.A2004193.005.250m 16 days NDVI.tif	25-Jan-2016 10:39	79M	
MOD13Q1.MRTWEB.A2005193.005.250m 16 days NDVI.tif	25-Jan-2016 10:39	79M	
MOD13Q1.MRTWEB.A2006193.005.250m 16 days NDVI.tif	25-Jan-2016 10:39	79M	
MOD13Q1.MRTWEB.A2007193.005.250m 16 days NDVI.tif	25-Jan-2016 10:40	79M	
MOD13Q1.MRTWEB.A2008193.005.250m 16 days NDVI.tif	25-Jan-2016 10:39	79M	
MOD13Q1.MRTWEB.A2009193.005.250m 16 days NDVI.tif	25-Jan-2016 10:40	79M	
MOD13Q1.MRTWEB.A2010193.005.250m 16 days NDVI.tif	25-Jan-2016 10:40	79M	
MOD13Q1.MRTWEB.A2015193.005.250m 16 days NDVI.tif	25-Jan-2016 10:40	79M	
Processing.log	25-Jan-2016 10:39	717	
TmpParamNDVI_MRT1453739912517_10_103948.log	25-Jan-2016 10:40	3.2K	
TmpParamNDVI_MRT1453739912517_10_103948.prm	25-Jan-2016 10:39	399	
TmpParamNDVI_MRT1453739912517_11_103951.log	25-Jan-2016 10:40	3.2K	
TmpParamNDVI_MRT1453739912517_11_103951.prm	25-Jan-2016 10:39	399	
TmpParamNDVI_MRT1453739912517_1_103911.log	25-Jan-2016 10:39	3.2K	
TmpParamNDVI_MRT1453739912517_1_103911.prm	25-Jan-2016 10:39	399	
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TmpParamNDVI_MRT1453739912517_4_103921.prm	25-Jan-2016 10:39	399	

Part 2: Display and Subset MODIS NDVI in QGIS

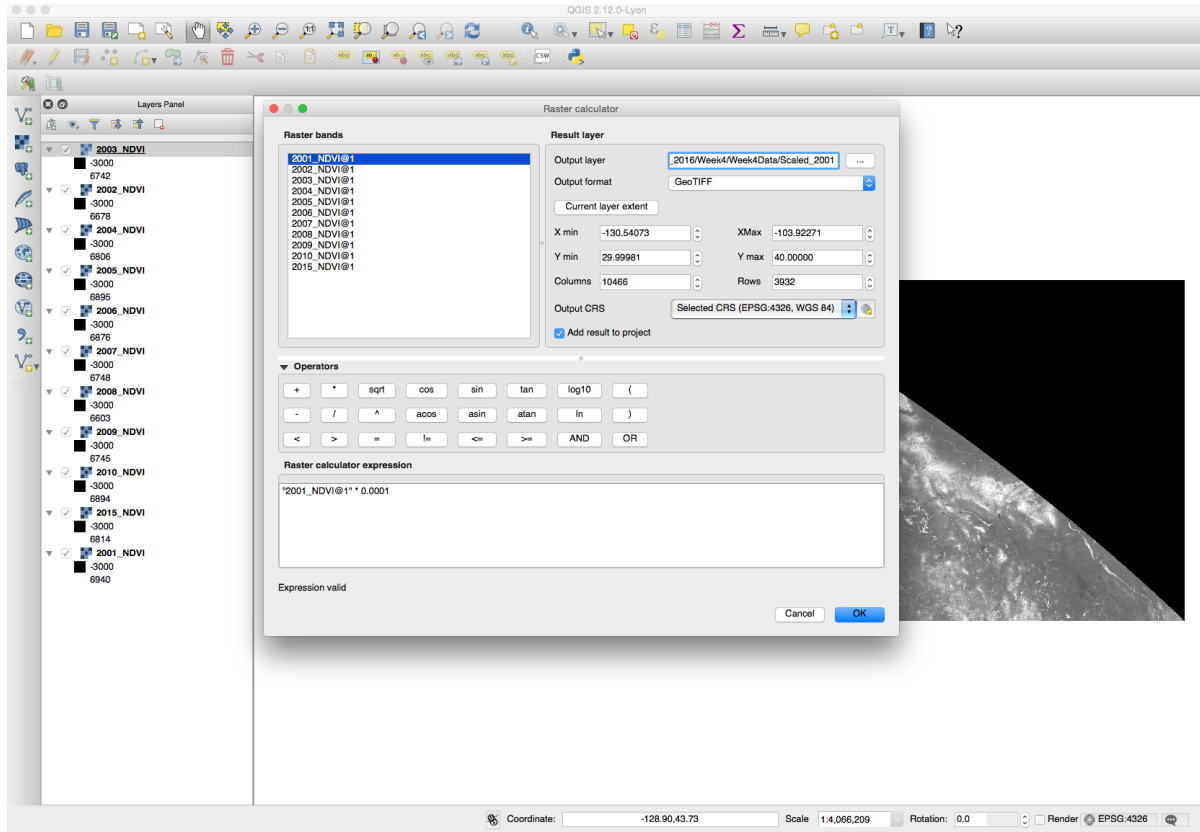
Use the method described in Session 1 and Session 2 to display the NDVI images. You do not need to put the images in one file. You can just load them into the display one at a time.

If you have stored your images in a folder with a long directory, you may want to rename your images with a short name (e.g. 2001_NDVI.tif). This will keep you from receiving errors when you add the data.

You will notice that the images show as greyscale colors in QGIS. You will also notice that the numbers do not range from -1 to 1 so you need to multiply each image by .0001. This is the scaling factor for MODIS images that we previously reviewed.

- Go to **Raster/Raster calculator**. The formula you will enter in the Raster calculator expression box is **NDVIimage*.0001**. Give it an output name (scaled2001) in the

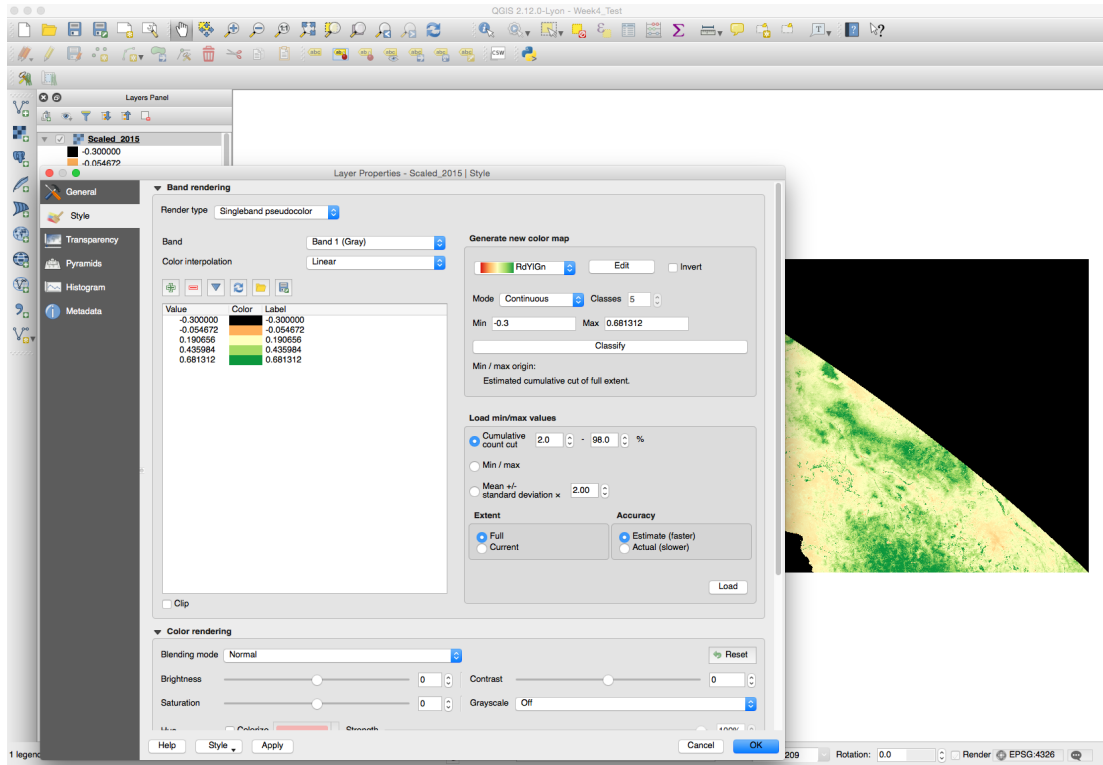
Output layer box. If you click on the button with 3 dots next to the box , you can make sure you are saving your image in the correct folder. Leave all other settings as default, and make sure the **Add results to project** box is checked. Click **OK**. Complete the same process for all of your images.



- Once you have all the new Scaled NDVI images in your map, you can remove all the original images. You can do this by right clicking on the layer in the **Layers Panel**, and click **Remove**.

If you would like to see your images in color, you can use the same method that we used in Session 2 to color the Landsat NDVI image, but with a small difference.

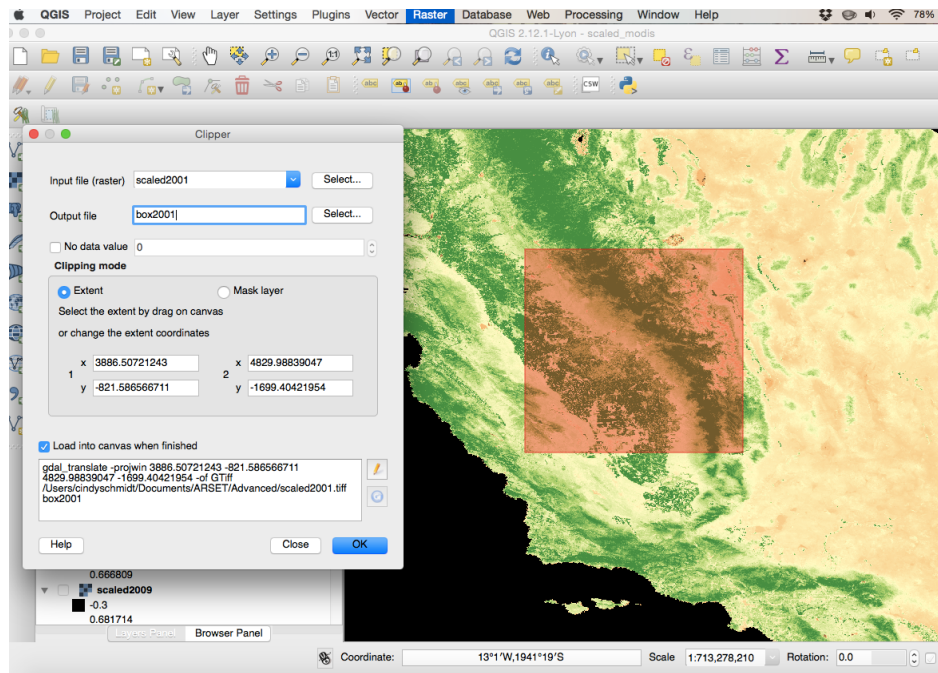
- Right click on the layer file and go to **Properties/Style**. Select the **Render Type** as **Singleband Pseudocolor**. Under **Generate new colormap**, make sure the color palette Red to Green is selected (RdYlGn). Leave the **Mode** as **Continuous** and **Classes** as **5**. Click **Classify**. Click **OK**.
- You will notice that the Pacific Ocean (and all other water bodies) is red. To change this, go to **Properties/Style** again. You will notice that -0.3 is red. In these NDVI images, -0.3 is the background value. To change the red color to black, double click on the red color box and move the slider in the color palette to black or click on the black standard color. Click **OK**. Click **OK** again. You can do this for all your images.



As a reminder, it is always a good idea to save your QGIS project along the way so your work is not lost.

Next, we will clip out a subset of the images. In this case, I am selecting a box, but you can also use a polygon (shape file) to do this.

- Go to **Raster/Extraction/Clipper**. Choose your input raster file and give it a name in the output file (box2001). Don't select the No data value unless your box or polygon goes outside the image area. In that case your No data value will be -0.3.
- For a user-defined box, select **Extent** and then draw a box on the image. You will see the coordinates show up in the coordinate boxes. Make sure **Load into canvas when finished** is selected. Then click **OK**, and the image will appear in your layers panel. Without closing the box, just change the name of the raster file and output file, and repeat for the remainder of your images. You can also write a small script to process these images all at once.



Part 3: Calculate NDVI Anomaly

Before you calculate the anomaly you might want to clean up your display window a bit.

- Remove all images except your Box (subset) images.

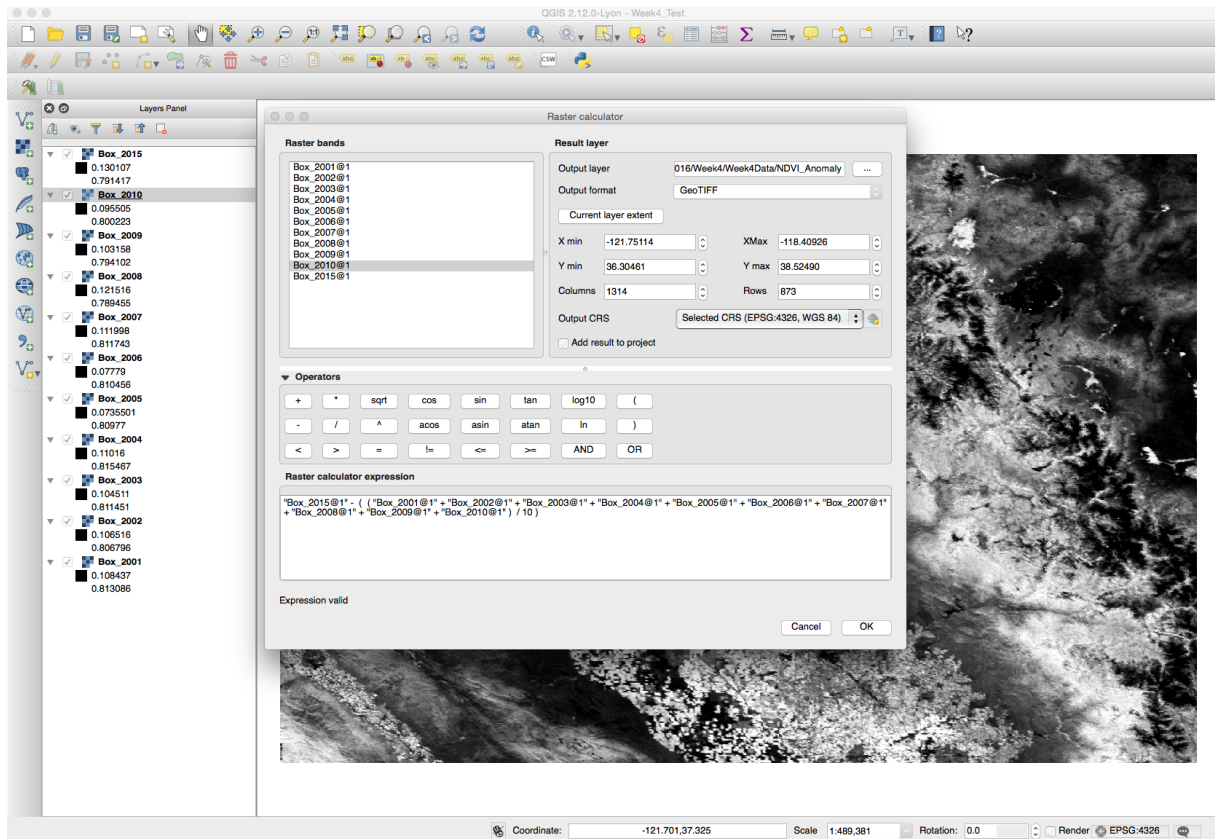
Next we will create an NDVI anomaly image from your subset images. What you are essentially doing here is creating an average NDVI for July from the 2001 to 2010 images. Then you are subtracting that average from the July 2015 values.

- Go to **Raster/Raster Calculator**.
- Put this expression in the Raster calculator expression:

Box2015 –
 $((\text{Box2001} + \text{Box2002} + \text{Box2003} + \text{Box2004} + \text{Box2005} + \text{Box2006} + \text{Box2007} + \text{Box2008} + \text{Box2009} + \text{Box2010}) / 10)$

Give your output layer a name (NDVI_anomaly).

Click OK.



The new image will appear in your display window. Since it is greyscale, you will want to color it using the same process as above. Since there are no background pixels in this image, there is no need to make any of the colors black.

Now you have successfully created your own NDVI anomaly images for July 2015. On the screenshot below you can see that many places within California's Central Valley have negative NDVI anomalies when compared to the 2001-2010 average. This could indicate drought and potentially fallowed land.

